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ABSTRACT

Data are reported from the fourth individual interview conducted in 1979 as part of a 3-year study on addition and subtraction using verbal problem solving. Ninety-nine second-grade children in two schools in Wisconsin that used the Developing Mathematical Processes program were individually administered six problem types (two solvable by addition and four solvable by subtraction) given under four conditions involving size of numbers and presence or absence of manipulative materials. Answers were coded by model, correctness, and strategy. Individual student profiles are discussed first, followed by a summary of pupil response data. Several important aspects of the summary data are isolated for contrast and comment. Finally, some secondary analyses of combined data are given. Appendices contain sample problem tasks and individual student profiles. (MNS)

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Working Paper 292

Results From Fourth Individual Interview (September 1979), Coordinated Study #1

by

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- developing and demonstrating improved instructional strategies, processes, and materials for students, teachers, and school administrators
- providing assistance to educators which helps transfer the outcomes of research and development to improved practice in local schools and teacher education institutions

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A major aim of mathematical instruction is to enable students to acquire concepts and skills requisite for solving problems of many types. A principle goal of mathematical education research is to understand how children acquire those concepts and skills and to understand how selected pedagogical and psychological factors are related to their acquisition. The Mathematics Work Group of the Wisconsin Research and Development Center for Individualized Schooling is presently conducting a program of research focused on a small set of those concepts and skills. Our interest lies in arithmetical learning, and in particular, in the acquisition of concepts and skills related to addition and subtraction of whole numbers.

The research program is attempting to relate pupil performance on selected arithmetic skills to pupil cognitive processes, instructional materials, and teachers' classroom behaviors. The interrelationship of these variables is depicted in Figure 1. Using this framework, we are proceeding to:

1. identify important addition and subtraction skills;
2. review past empirical data or collect new data on these skills;
3. re-examine these mathematical skills and hypothesize how they are related to underlying cognitive skills;
4. examine the instructional materials designed to teach these skills; and
5. conduct a series of empirical studies on the appropriateness of particular teacher classroom behaviors, the appropriateness of instructional materials, and the relationship of specific cognitive skills to

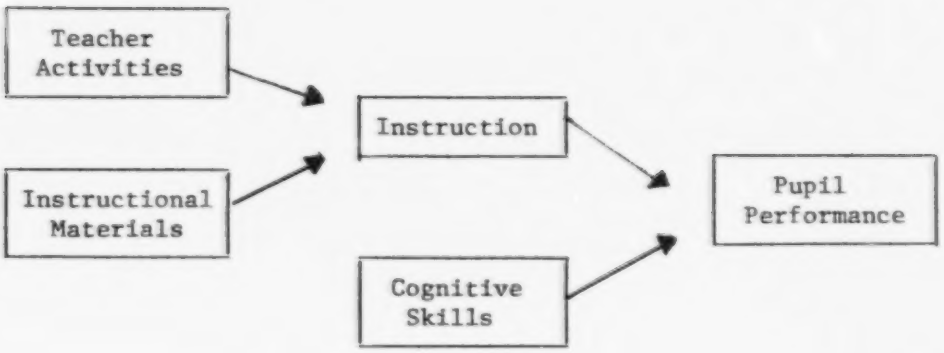

Figure 1. Factors influencing pupil performance.

mathematical skills.

The work of the Mathematics Work Group is built around the conceptual framework exemplified in Figure 1. The empirical and theoretical investigations generally involve two or more of the factors depicted, and have been organized into four major categories. These are a conceptual paper series, a set of short empirical studies, a major longitudinal study, and an invitational conference of scholars.

This paper relates to the longitudinal study. Approximately 150 students in three separate schools were identified as subjects for the study. One school with about 50 students chose not to continue into the second year of the study. Thus, about 100 children are being followed for three school years. Pupil performance is measured in several ways:

1. Individual interviews. At several times during each school year, individual children are administered a set of problem tasks dealing with addition and subtraction. The interviewer attempts to ascertain the children's solution strategy, correctness of answer, type of errors made, and modeling procedures.

2. Group administered paper-and-pencil tests. There are two separate categories of tests:

    a. Achievement monitoring. These tests measure pupil progress toward a set of performance objectives that are contained in the instructional materials. By means of matrix sampling procedures, estimates are made of group performance. Achievement monitoring tests are given shortly after the completion of the instructional units related to arithmetic objectives.

b. Topic inventories. These are very short tests that measure pupil progress toward mastery of the objectives of a specific instructional unit, or topic. Every subject takes the same test, resulting in a measure of individual performance.

Instruction and classroom environment are assessed by direct classroom observation of teacher actions, pupil behaviors, and instructional materials. A trained observer is present each day the instructional units, or topics, dealing with arithmetic objectives are being used. Organizational and grouping measures are noted, along with indications of interactions between teacher and pupils, and among pupils. Measures of pupil engaged time are estimated by observing six target students.

The purpose of this paper is to report on the data from the fourth round of individual interviews for the longitudinal study, which were carried out during September 1979. In the first major section we present all the background information on subjects and the manner of data collection. In the following two major sections, summaries and interpretations of the data are given. Some of the actual data collected in the interviews appears in the Appendices.

Background Information

This section contains background information needed to understand the data summaries given in the next section. As indicated in the various subsections, greater detail may be obtained by referring to other reports from the Mathematics Work Group.

Population and Curriculum Materials

The fourth interview of individual children was carried out during the

period September 4-6, 1979, at the two participating schools:

School 1: a public school in Monona, Wisconsin.

School 3: a parochial school in Madison, Wisconsin.

The subjects consisted of 100 second grade students, all from predominantly middle class areas, who had parental permission to participate in the interviews. Table 1 presents the number of children who participated in the study in each school and information about their age at the time of the fourth interview.

Each school used as their mathematics curriculum the Developing Mathematical Processes (DMP) program (Romberg, Harvey, Moser, and Montgomery, 1974). The following sequence of topics was suggested to the six teachers involved in the second year of the study: S-4, 30, S-5, 31, S-6, 33, A-1, 36, A-2, 39, A-3, 37 or 41, A-4. The S-series and A-series topics were specially prepared for the Coordinated Study (see Kouba & Moser, Note 1 and Note 2).

The interviews were begun at the start of the 1979-1980 school year, prior to the instruction of Topic S-4. By this time in their mathematics instruction the children had been introduced to solving problem situations involving the numbers 0-20 with mastery of the addition and subtraction basic facts 0-10 expected.

Interview Tasks

The interview consisted of six problem types (tasks) given under four conditions. The four conditions are described later. The six types included two problems solvable by addition of the two given numbers and four problems solvable by subtraction of the two given numbers. The characterization for these six problem types is detailed in Moser (Note 3) and in Carpenter and

Table 1

Number and Age of Population by School

	School 1	School 3	Total
Number of children	65	34	99
Mean age	7 yr. 4 mo.	7 yr. 6 mo.	7 yr. 5 mo.
Maximum age	8 yr. 2 mo.	8 yr. 1 mo.	8 yr. 2 mo.
Minimum age	6 yr. 9 mo.	6 yr. 8 mo.	6 yr. 9 mo.
Male	36	22	58
Female	29	12	41

Moser (Note 4).

Table 2 present representative problems and the order in which the problems were administered to the children. The actual wording for each problem type differed in the four conditions, but the semantic structure remained constant. The actual problems administered are given in Appendix A.

Within each problem, two of three numbers from a number triple (x, y, z) defined by $x + y = z$, $x < y < z$, were given. In the two addition problems x, y were presented, with the smaller number x always given first. In the four subtraction problems, z and the larger addend y were presented. The order of presentation of y and z varied among problem types.

The six problem types were presented under four conditions that result from crossing smaller numbers vs. larger numbers with presence vs. absence of manipulative materials. Figure 2 shows these four conditions with the labels assigned to them. In the b+ and c+ conditions approximately 30 small plastic cubes about equally divided between blue cubes and orange cubes were available to the child to use as manipulatives if desired.

The actual number triples used in the problems are listed in Table 3. We hypothesized before the interviews began that the four conditions would constitute different levels of difficulty with the b+ condition proving the easiest and the c- the most difficult. The ordering of difficulty of b- and c+ was left to the empirical results. The four conditions became known as the four levels, and that terminology will be used in the remainder of this paper.

The assignment of the number triples (small and large domains) to problem types involved a six-by-six Latin square design resulting in six sets of the

Table 2

Representative Problem Types

Task 1. Joining (Addition)	Pam had 3 shells. Her brother gave her 6 more shells. How many shells did Pam have latogether?
Task 2. Separating (Subtraction)	Jenny had 7 erasers. She gave 5 erasers to Ben. How many erasers did Jenny have left?
Task 3. Part-Part-Whole, Missing Addend (Subtraction)	There are 5 fish in a bowl. 3 are striped and the rest are spotted. How many spotted fish are in the bowl?
Task 4. Part-Part-Whole (Addition)	Matt has 2 baseball cards. He also has 4 football cards. How many cards does Matt have altogether?
Task 5. Comparison (Subtraction)	Angie has 4 lady bugs. Her brother Todd has 7 lady bugs. How many more lady bugs does Todd have than Angie?
Task 6. Joining Missing Addend (Subtraction)	Gene has 5 marshmallows. How many more marshmallows does he have to put with them so he has 8 marshmallows altogether?

		Number Size: smaller	Number Size: larger
Presence of manipulatives	with	b+	c+
	without	b-	c-

Figure 2. Conditions for nonsymbolic problem types.

Table 3

Listing of Number Triples Used in Verbal Problems

Smaller numbers	Larger numbers
2-3-5	3-8-11
2-4-6	4-7-11
2-5-7	5-7-12
3-4-7	4-9-13
2-6-8	6-8-14
3-6-9	6-9-15

six problem types. These sets were uniformly and randomly distributed across subjects. The Latin squares for the small number domain (b) and the large number domain (c) are presented in Tables 4 and 5 respectively. The number in the box (□) in each entry represents the solution the children were to find. The order of the other two given numbers in the tables corresponds to the order in which those numbers appeared in the problem (cf. Table 2). The assignment of problem sets to subjects is listed in Appendix C.

Task sets for a particular level were assigned to children so that the same number triple did not occur in the same problem type (task) in any subsequent interview.

Interview Method

Trained interviewers (see Martin & Moser, Note 5 for details of interviewer training and reliability) administered the interviews. The entire interview process for both schools lasted from the 4th to the 6th of September 1979. Three interviewers worked at a given school on each day. Interviews began soon after school started and continued through the day, with the usual breaks at lunch and recess. Table 6 details the assignment of interviewers to schools.

Each interviewer was able to conduct 8 to 18 interviews in a day, depending on the schools' schedules and on the task level. (Level c tasks took longer than level b tasks.) At the schools the interviewers were assigned interview areas, which, for the most part, were quiet rooms separate from distracting activities.

The interviewers went to the classroom to get a child, and they visited together on the way to the interview area. The verbal tasks were reread to

Table 4

b+ and b- Number Triples

Set Number	Task 1	2	3	4	5	6
1	3,6, [9]	7,5, [2]	5,3, [2]	2,4, [6]	4,7, [3]	6,8, [2]
2	2,6, [8]	7,4, [3]	6,4, [2]	3,6, [9]	3,5, [2]	5,7, [2]
3	2,5, [7]	8,6, [2]	9,6, [3]	3,4, [7]	4,6, [2]	3,5, [2]
4	3,4, [7]	6,4, [2]	8,6, [2]	2,3, [5]	5,7, [2]	6,9, [3]
5	2,4, [6]	5,3, [2]	7,5, [2]	2,6, [8]	6,9, [3]	4,7, [3]
6	2,3, [5]	9,6, [3]	7,4, [3]	2,5, [7]	6,8, [2]	4,6, [2]

Table 5

c+ and c- Number Triples

Set Number	Task 1	2	3	4	5	6
1	6,9, [15]	13,9, [4]	11,8, [3]	4,7, [11]	7.12, [5]	8,14, [6]
2	6,8, [14]	12,7, [5]	11,7, [4]	6,9, [15]	8,11, [3]	9,13, [4]
3	4,9, [13]	14,8, [6]	15,9, [6]	5,7, [12]	7,11, [4]	8,11, [3]
4	5,7, [12]	11,7, [4]	14,8, [6]	3,8, [11]	9,13, [4]	9,15, [6]
5	4,7, [11]	11,8, [3]	13,9, [4]	6,8, [14]	9,15, [6]	7,12, [5]
6	3,8, [11]	15,9, [6]	12,7, [5]	4,9, [13]	8,14, [6]	7,11, [4]

Table 6

Interviewer School Assignment

Interviewer Code #	Date 9/4	9/5	9/6
12	Sch 1	Sch 1	Sch 1
30	Sch 1	Sch 1	Sch 1
34	Sch 3	Sch 3	Sch 3
38	Sch 3	Sch 3	Sch 3
41		Sch 1	
45	Sch 3		
47	Sch 3		Sch 1
58			Sch 3
72	Sch 1	Sch 3	

the child as often as necessary so that remembering the given numbers or relationships caused no difficulty.

An individual interview required two sessions, one for b+ and b-, and the other for c+ and c- tasks. The sessions lasted 10-20 minutes each, with each child receiving the same sequence of problems. No child was interviewed twice in one day.

If a child had extreme difficulty in responding to b+ tasks, the interview was broken off at that level. After each level, the interviewer decided whether the child should proceed to the next level in the sequence b+, b-, c+, c-.

Coding Subject Responses

All of the possible student responses are presented in detail in Cookson and Moser (Note 6). Only a brief description is presented here. The coding sheet upon which responses were recorded is shown in Figure 3.

Model

C The child used cubes to model (all or part of) the problem.

F The child used fingers to model.

N The child used no physical model.

O The child used some other physical model, such as chairs, numerals on a clock face.

Correctness

Y The answer was correct.

N The answer was not correct.

UN Uncodable: The child gave an answer, but the interviewer was unable to identify the strategy used.

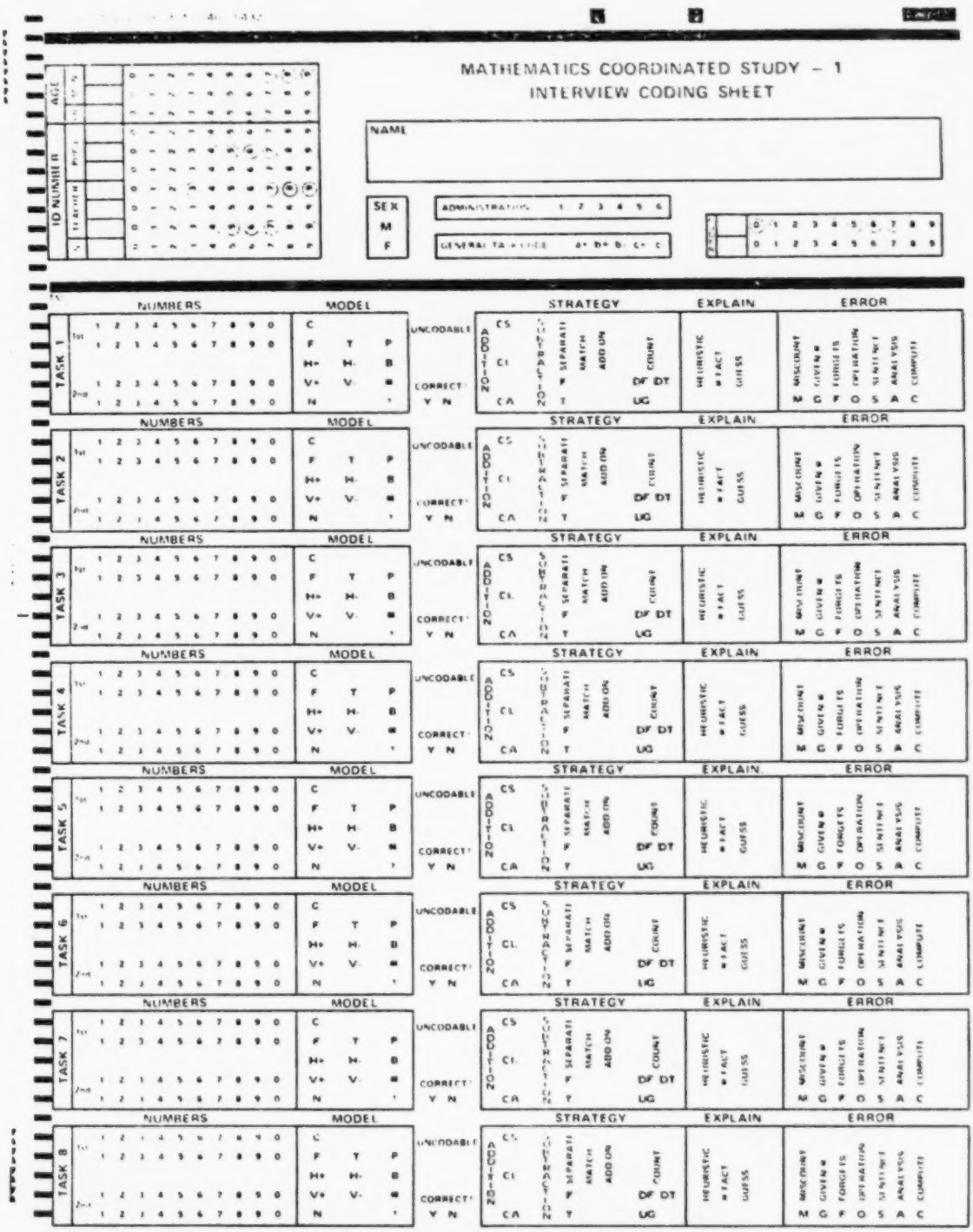

Figure 3. Electronially scored interviewer coding sheet.

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Strategy

Addition:

CS Counting On from Smaller or Counting On from First Number: When counting cubes, fingers, or mentally, the counting sequence began either with the smaller number (first number given in the story) or the successor of that number.

CL Counting On from Larger: The counting sequence began with the larger (second) given number or with the successor of that number.

CA Counting All: The child counted the complete union of the sets represented in the problem, with counting sequence started at "one, two, ..."

S Subitizing: The child models the two addends and "recognizes" the sum without counting.

Subtraction:

F Separate From: The child models the larger given set and then takes away or separates, one at a time, a number of cubes or objects equal to the smaller given number in the problem. Counting the remainder set gives the answer.

T Separate To: After the larger set is modeled, the child removes cubes or objects one at a time until the remainder is equal to the second given number in the problem. Counting the number of objects removed gives the answer.

MA Match: The child puts out two sets of cubes or objects, each set standing for one of the given numbers. The sets are then matched one-to-one. Counting the excess of the larger set over the smaller set gives the answer.

AO Add On: The child sets out a number of cubes or objects equal to the smaller given number (an addend). The child then adds cubes to that set one at a time until the new collection is equal to the larger given number. Counting the number of cubes added on gives the answer.

DF Count Down From: A child initiates a backwards counting sequence beginning with the larger given number. The backwards counting sequence contains as many counting number words as the smaller given number. The last number uttered in the counting sequence is the answer.

DT Count Down To: A child initiates a backwards counting sequence beginning with the larger given number. The sequence ends with the given smaller number. By keeping track of the number of counting words uttered in this sequence, the child determines the answer to be the number of counting words used in the sequence.

UG Count Up from Given: A child initiates a forward counting sequence beginning with the smaller given number. The sequence ends with the larger given number. Again, by keeping track of the number of counting words uttered in sequence, the child determines the answer.

Addition and Subtraction (Explain or Mental Processes):

HU Heuristic: Heuristic strategies were employed to generate solutions from a small set of known basic facts. These strategies usually were based on doubles or numbers whose sum was 10.

#F Number Fact: The child gave a correct answer with the justification that it was the result of knowing some basic addition/subtraction fact.

GU Guess: The child gave an answer with the justification that it was the result of guessing.

Error:

M Miscount: The child miscounted in some way.

G (GI) Given Number: The child responded that the answer was one of the two numbers given in the problem.

F Forgets: The child forgot one of the given numbers and thereby found an incorrect answer.

O (OP) Operation: The child used an addition strategy in a problem that must be solved through subtraction, or a subtraction strategy was employed in an addition problem.

None of the other items under model, strategy, and error on the coding sheets was used for this interview.

Presentation of the Data

Data were collected on children's behavior following presentation of a specific verbal problem. The six different verbal problem types were presented at four different levels, resulting in a maximum of 24 tasks for an individual child. For reasons to be explained later, not all children received all tasks. Of the 99 children who began the interviews only 88 were administered the complete set of 24 tasks.

This section begins with a discussion of individual student profiles, which comprise the basic raw data, followed by a summary of pupil response data. Several important aspects of the summary data are isolated for contrast and comment. The following major section will present some secondary analyses of combined data.

Individual Student Profiles

A record of each subject's response to the 24 tasks was compiled from the coding sheets. These profiles are the basis for all other statistical information appearing in this paper. The profiles for all subjects are contained in Appendix B. Figure 4 provides an example of a student profile.

For each task at each level, the four coded entries in order from left to right are model, correctness, strategy, and error. The abbreviations used are explained in the previous section. In the strategy column (as in much of the data analysis for this study) Uncodable (UN), Given Number (GI), and Operation (OP) were treated as strategies.

The hundreds digit of the student ID number identified which school the student attended: 1 or 3 (see Table 1).

The actual problem and numbers used in the problem for a given level and task can be obtained by using the following procedure. For example, what was the actual problem read to Student 111 for Task 2 at the b- level?

1. Use Appendix A, Problem Tasks by Level, to find the exact wording for Task 2 at the b- level:

> Marie had ____ candles.
> She gave ____ candles to Fran.
> How many candles did Marie have left?

2. Use Appendix C, Number Set Assignment, to find what set was assigned to Student 111 at the b- level. The entry in the b- column for ID #111 is 3.

3. Use Table 4, b+ and b- Number Triples, to find what number triple was assigned to set 3, Task 2. The entry in this table is 7,4, [3] , where [3] indicates that 3 is the correct solution. Therefore, Student #111 was given the following problem for Task 2, level b-:

Student ID Number

111	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	F Y F -	N Y #F -	F Y MA -	N Y #F -
c+	C Y HU -	C Y T -	C N F M	C Y CS -	C N MA M	C Y AO -
c-	N Y #F -	F Y HU -	F Y F -	F Y CS -	- ? ? -	N Y #F -

Level

model
correct
error
strategy

Figure 4. Sample student profile.

Marie had 7 candles.
She gave 4 candles to Fran.
How many candles did Marie have left?

Looking at the entry in Figure 4, we can resconstruct this child's behavior on Task 2 at the b- level. The N means that the child did not physically model the numbers, and, in fact, showed no action. The Y indicates that the child's answer was correct. The #F indicates that the child answered the problem quickly with a known number fact. Whether this fact was 4 + 3 = 7 or 7 - 4 = 3 is not indicated in the coding. The dash in the error column shows that the child made no error in solving the problem.

Some general understanding of individual students can be achieved by looking at a profile. For example, when considering Figure 4 for Student 111, one might conclude:

1. The student knows only a few number facts beyond 10 and is not certain of some 0-10 facts.

2. The student uses no consistent model or strategy across tasks or levels.

A Summary of Behaviors by Task and Level

Each of the four major categories of responses - modeling, correctness, strategy, and error - have been summarized for each of the 24 tasks presented. As indicated in the first major section of this paper, a six-by-six Latin square design was used to distribute the number triples across tasks and across subjects. An initial, informal statistical analysis of the number triples as a variable affecting subject responses showed that the triples have little effect.

Three population subsets. The general goal for the interviews was to present each child with the b+ and b- problems during the first interview

session and with the c+ and c- problems during the second session a day or two later. However, not all children were capable of solving all problems. The interviewer had the responsibility to determine at what point a particular level was inappropriate for a child. These guidelines were used:

1. If during the b+ portion of the interview the child fails to use any coherent or identifiable strategies while trying to solve three of the first four problems, terminate the b portion.

2. If the child solves two of the first four b+ problems, but is baffled by the last two problems, i.e., solves two of the six problems, terminate the b portion of the interview.

The interview was terminated, not because three of the four problems were incorrect, but because the child was perplexed by the problem and employed highly inappropriate strategies or because the interviewer was unable to determine what strategies were being employed.

3. If the child solved at least two of the first four and at least one of the last two of the b+ problems, present the b- problems. The b- portion should be completed unless the child cannot solve three of the first four problems.

4. The decision whether the child should go on the c portion was made at the end of the b interview.

All but one child completed the b interview.

The procedure for determining whether to terminate the c+ or c- level interview followed the same guidelines as those given above. The overriding issue was always the well-being of the child. It would have been unfair to interview further any child who was frustrated or unduly confused by the

problems. In a few cases, a decision was made to branch only to c+ problems for some children who relied heavily on physical modeling and did well with the b+ problems, but failed to solve b- problems. For these children, then, it was inferred that they could not solve c- problems but that c+ problems might be within their problem solving abilities.

As a result of the policy of terminating the interview before completion for many children, three sets of subjects were identified.

Total population N=99. This is the total interview population and consists of all children who were interviewed, no matter when the interview terminated.

Real population $88 \leq N \leq 99$. This is the number of subjects who actually were administered each task. This number can change for each task or level.

Successful population N=88. This is the number of subjects who were administered all 24 tasks.

The results describe only the Total population, for that is the most representative of the childrens' responses. Although the decisions to terminate interviews resulted in incomplete data for a small number of students, the decision rules were designed so that it is valid to assume that the child would have given incorrect answers or used uncodable strategies on the questions that were presented. That is, the child consistently had been giving uncodable incorrect answers or was simply confused on all previous problems. Thus, it was a reasonable assumption that subsequent responses would follow the same pattern.

The statistics for the real and the successful population have been compiled and a copy may be obtained by writing the Mathematics Work Group at the R & D Center.

A table for each of the six tasks is presented (Table 7-12). All four levels for each task are contained in the same table. The uncodable (UN) and confused (?) responses are included in the strategy category. All data are based on the total of 99 subjects.

Levels of Difficulty

Prior to administration of the interviews, it was hypothesized that the four interview conditions, b+, b-, c+, c-, would represent sequential levels of difficulty. The number of students responded correctly to each task(Table 13) under each condition generally supports this hypothesis although there appears to be essentially no difference between the b+ and b- levels.

Comparative Difficulty of Addition vs. Subtraction

Results from the fourth interview are consistent with previous research findings that addition tends to be easier than subtraction. The average number of correct responses per level for the two addition problems was compared to the average number of correct responses for all four subtraction problems. Since two of the subtraction problems, Task 3; Part-Part-Whole, missing addend and Task 5: Comparison, proved to be much more difficult than the others, a comparison was also made between the averages for the two addition problems and the averages for the two easier subtraction problems. Either way, Table 14 demonstrates the relative difficulties.

Similarity of Response Patterns for the Two Addition Tasks

An earlier pilot study (Carpenter, Hiebert and Moser, Note 7) used the same two addition tasks and found almost no difference in the responses given by children to those tasks. The results from the fourth interview reflect this same consistency of response. It would appear that children of the age

Table 7

Task 1 (Addition-Joining)

Number (%) of Children Coded for a Particular Behavior

		Level			
		b+	b-	c+	c-
C	Cubes	36(36%)	0(0%)	53(54%)	0(0%)
F	Fingers	6(6%)	33(33%)	11(11%)	37(37%)
N	No Action	57(58%)	65(66%)	34(34%)	48(48%)
O	Other	0(0%)	0(0%)	0(0%)	3(3%)
Y	Correct	91(92%)	88(89%)	83(84%)	71(72%)
UN	Uncodable	3(3%)	6(6%)	2(2%)	3(3%)
?	Confusion	0(0%)	0(0%)	0(0%)	1(1%)
CS	Counts On from Smaller	3(3%)	9(9%)	14(14%)	15(15%)
CL	Counts On from Larger	11(11%)	9(9%)	26(26%)	27(27%)
S	Subitizing	2(2%)	1(1%)	0(0%)	0(0%)
CA	Counts All	31(31%)	15(15%)	41(41%)	16(16%)
HU	Heuristic	5(5%)	8(8%)	6(6%)	9(9%)
#F	Number Fact	41(41%)	47(47%)	6(6%)	13(13%)
GU	Guess	3(3%)	2(2%)	1(1%)	3(3%)
GI	Given Number	0(0%)	0(0%)	0(0%)	1(1%)
OP	Wrong Operation	0(0%)	1(1%)	0(0%)	0(0%)
M	Miscount	2(2%)	1(1%)	11(11%)	6(6%)
F	Forgets Data	2(2%)	3(3%)	1(1%)	0(0%)
	Not administered	0(0%)	1(1%)	3(3%)	11(11%)

Table 8

Task 2 (Subtraction-Separating)

Number (%) of Children Coded for a Particular Behavior

		Level			
		b+	b-	c+	c-
C	Cubes	48(48%)	0(0%)	58(59%)	0(0%)
F	Fingers	8(8%)	42(42%)	7(7%)	43(43%)
N	No Action	43(43%)	56(57%)	29(29%)	40(40%)
O	Other	0(0%)	0(0%)	1(1%)	5(5%)
Y	Correct	82(83%)	80(81%)	69(70%)	52(53%)
UN	Uncodable	5(5%)	11(11%)	5(5%)	10(10%)
?	Confusion	0(0%)	0(0%)	1(1%)	6(6%)
F	Separate from	53(54%)	35(35%)	57(58%)	25(25%)
T	Separate to	0(0%)	0(0%)	1(1%)	0(0%)
MA	Match	0(0%)	0(0%)	0(0%)	0(0%)
AO	Add On	0(0%)	1(1%)	0(0%)	1(1%)
DF	Count Down from	1(1%)	8(8%)	4(4%)	12(12%)
UG	Count Up from Given	3(3%)	2(2%)	5(5%)	12(12%)
DT	Count Down to	1(1%)	0(0%)	0(0%)	2(2%)
HU	Heuristic	2(2%)	3(3%)	5(5%)	9(9%)
#F	Number Fact	26(26%)	33(33%)	10(10%)	8(8%)
GU	Guess	3(3%)	3(3%)	6(6%)	2(2%)
GI	Given Number	1(1%)	0(0%)	0(0%)	1(1%)
OP	Wrong Operation	4(4%)	2(2%)	2(2%)	0(0%)
M	Miscount	5(5%)	4(4%)	9(9%)	10(10%)
F	Forgets Data	3(3%)	3(3%)	3(3%)	3(3%)
	Not administered	0(0%)	1(1%)	3(3%)	11(11%)

Table 9

Task 3 (Subtraction-Part-Part-Whole, missing addend)

Number (%) of Children Coded for a Particular Behavior

		Level			
		b+	b-	c+	c-
C	Cubes	45(45%)	0(0%)	53(54%)	0(0%)
F	Fingers	8(8%)	39(39%)	6(6%)	39(39%)
N	No Action	45(45%)	58(59%)	35(35%)	45(45%)
O	Other	0(0%)	0(0%)	0(0%)	3(3%)
Y	Correct	75(76%)	75(76%)	56(57%)	46(46%)
UN	Uncodable	7(7%)	8(8%)	5(5%)	7(7%)
?	Confusion	2(2%)	2(2%)	3(3%)	6(6%)
F	Separate from	41(41%)	31(31%)	50(50%)	11(11%)
T	Separate to	0(0%)	0(0%)	0(0%)	0(0%)
MA	Match	0(0%)	0(0%)	0(0%)	0(0%)
AO	Add On	0(0%)	1(1%)	1(1%)	3(3%)
DF	Count Down from	3(3%)	4(4%)	2(2%)	4(4%)
UG	Count Up from Given	4(4%)	7(7%)	12(12%)	22(22%)
DT	Count Down to	0(0%)	0(0%)	0(0%)	2(2%)
HU	Heuristic	2(2%)	2(2%)	7(7%)	4(4%)
#F	Number Fact	29(29%)	31(31%)	5(5%)	10(10%)
GU	Guess	5(5%)	7(7%)	6(6%)	13(13%)
GI	Given Number	6(6%)	2(2%)	4(4%)	5(5%)
OP	Wrong Operation	0(0%)	3(3%)	1(1%)	1(1%)
M	Miscount	3(3%)	5(5%)	17(17%)	8(8%)
F	Forgets Data	6(6%)	1(1%)	2(2%)	3(3%)
	Not administered	0(0%)	1(1%)	3(3%)	11(11%)

Table 10

Task 4 (Addition-Part-Part-Whole)

Number (%) of Children Coded for a Particular Behavior

		Level			
		b+	b-	c+	c-
C	Cubes	38(38%)	0(0%)	51(52%)	0(0%)
F	Fingers	5(5%)	32(32%)	9(9%)	39(39%)
N	No Action	56(57%)	65(66%)	37(37%)	46(47%)
O	Other	0(0%)	1(1%)	0(0%)	3(3%)
Y	Correct	92(93%)	89(90%)	71(72%)	65(66%)
UN	Uncodable	4(4%)	8(8%)	4(4%)	3(3%)
?	Confusion	0(0%)	0(0%)	0(0%)	2(2%)
CS	Counts On from Smaller	3(3%)	6(6%)	6(6%)	14(14%)
CL	Counts On from Larger	15(15%)	21(21%)	29(29%)	38(38%)
S	Subitizing	5(5%)	6(6%)	0(0%)	0(0%)
CA	Counts All	27(27%)	11(11%)	39(39%)	12(12%)
HU	Heuristic	4(4%)	5(5%)	4(4%)	7(7%)
#F	Number Fact	37(37%)	36(36%)	7(7%)	7(7%)
GU	Guess	3(3%)	4(4%)	7(7%)	5(5%)
GI	Given Number	0(0%)	1(1%)	0(0%)	0(0%)
OP	Wrong Operation	1(1%)	0(0%)	0(0%)	0(0%)
M	Miscount	3(3%)	1(1%)	13(13%)	5(5%)
F	Forgets Data	3(3%)	4(4%)	0(0%)	2(2%)
	Not administered	0(0%)	1(1%)	3(3%)	11(11%)

Table 11

Task 5 (Subtraction-Comparison)

Number (%) of Children Coded for a Particular Behavior

		Level			
		b+	b-	c+	c-
C	Cubes	34(34%)	0(0%)	52(53%)	0(0%)
F	Fingers	9(9%)	32(32%)	9(9%)	27(27%)
N	No Action	53(54%)	63(64%)	35(35%)	53(54%)
O	Other	0(0%)	0(0%)	0(0%)	4(4%)
Y	Correct	73(74%)	74(76%)	58(59%)	47(48%)
UN	Uncodable	12(12%)	15(15%)	8(8%)	10(10%)
?	Confusion	2(2%)	4(4%)	2(2%)	7(7%)
F	Separate from	8(8%)	4(4%)	14(14%)	4(4%)
T	Separate to	0(0%)	0(0%)	0(0%)	0(0%)
MA	Match	14(14%)	6(6%)	25(25%)	1(1%)
AO	Add On	3(3%)	3(3%)	3(3%)	4(4%)
DF	Count Down from	1(1%)	0(0%)	2(2%)	4(4%)
UG	Count Up from Given	14(14%)	18(18%)	17(17%)	24(24%)
DT	Count Down to	1(1%)	1(1%)	1(1%)	3(3%)
HU	Heuristic	2(2%)	3(3%)	1(1%)	4(4%)
#F	Number Fact	28(28%)	28(28%)	9(9%)	7(7%)
GU	Guess	2(2%)	5(5%)	6(6%)	12(12%)
GI	Given Number	8(8%)	6(6%)	5(5%)	5(5%)
OP	Wrong Operation	3(3%)	5(5%)	3(3%)	3(3%)
M	Miscount	3(3%)	0(0%)	14(14%)	5(5%)
F	Forgets Data	5(5%)	1(1%)	1(1%)	1(1%)
	Not administered	1(1%)	1(1%)	3(3%)	11(11%)

Table 12

Task 6 (Subtraction-Joining, missing addend)

Number (%) of Children Coded for a Particular Behavior

		Level			
		b+	b-	c+	c-
C	Cubes	34(34%)	0(0%)	44(44%)	0(0%)
F	Fingers	5(5%)	35(35%)	11(11%)	41(41%)
N	No Action	59(60%)	63(64%)	42(42%)	44(44%)
O	Other	0(0%)	0(0%)	0(0%)	2(2%)
Y	Correct	89(90%)	85(86%)	81(82%)	67(68%)
UN	Uncodable	8(8%)	8(8%)	11(11%)	8(8%)
?	Confusion	0(0%)	0(0%)	0(0%)	3(3%)
F	Separate from	0(0%)	0(0%)	4(4%)	0(0%)
T	Separate to	0(0%)	0(0%)	0(0%)	0(0%)
MA	Match	0(0%)	1(1%)	1(1%)	0(0%)
AO	Add On	25(25%)	24(24%)	36(36%)	15(15%)
DF	Count Down from	0(0%)	1(1%)	0(0%)	2(2%)
UG	Count Up from Given	15(15%)	22(22%)	26(26%)	42(42%)
DT	Count Down to	0(0%)	0(0%)	0(0%)	0(0%)
HU	Heuristic	2(2%)	0(0%)	5(5%)	5(5%)
#F	Number Fact	41(41%)	35(35%)	9(9%)	8(8%)
GU	Guess	3(3%)	4(4%)	4(4%)	5(5%)
GI	Given Number	1(1%)	2(2%)	0(0%)	0(0%)
OP	Wrong Operation	3(3%)	1(1%)	0(0%)	0(0%)
M	Miscount	1(1%)	3(3%)	5(5%)	6(6%)
F	Forgets Data	1(1%)	3(3%)	1(1%)	1(1%)
	Not administered	1(1%)	1(1%)	3(3%)	11(11%)

Table 13

Number of Correct Responses Per Task Across Levels

	Level			
Task	b+	b-	c+	c-
1	91	88	83	71
2	82	80	69	52
3	75	75	56	46
4	92	89	71	65
5	73	74	58	47
6	89	85	81	67

represented by this sample do not differentiate between an action-oriented Joining addition problem and a static Part-Part-Whole addition problem. Table 15 presents the contrasts between the two problems on a level-by-level basis. Similar results were noted in the previous interviews.

Subtraction Strategies and Problem Structure

Unlike the monolithic characterization of addition in the previous section, subtraction is not amenable to a single simple interpretation. A number of writers (e.g., Gibb, 1956) have suggested three interpretations, or structures, underlying subtraction. They are the subtractive, the additive, and the comparative. The four problem tasks were chosen with this categorization in mind. Task 2, Separating, reflects the subtractive notion in that its semantic structure strongly suggests the use of the separating or take-away strategy. Task 6, Joining, missing addend, reflects the additive notion in that its semantic structure suggests the additive strategy of adding-on or making a smaller set larger. Task 5, Comparison, reflects the static notion of comparison by suggesting neither adding on nor taking away, but rather a matching or contrasting of two sets. Task 3, Part-Part-Whole, missing addend, is the least suggestive of the four subtraction tasks since its semantic structure does not clearly indicate what strategy is most appropriate.

For purposes of discussion, the Separating From (F), Separating To (T), Counting Down From (DF) and Counting Down To (DT) strategies will be aggregated into a single subtractive category. Similarly, the Adding On (AO) and Counting Up from Given (UG) strategies will be aggregated into a single additive strategy. And finally, Matching (MA) is essentially the comparative strategy.

Table 14

Average Number of Correct Responses for

Addition and Subtraction Problems by Level

Type	Level			
	b+	b-	c+	c-
Tasks 1, 4 (Addition)	92	89	77	68
Tasks 2, 3, 5, 6 (Subtraction)	80	79	66	53
Tasks 2, 6 (Easier Subtraction)	86	83	75	60

Table 15

Number of Responses on Two Verbal Addition Problems

		Model			Correct	Strategy				
		C	F	N	Y	CA	CS	CL	#F	HU
b+	Joining	36	6	57	91	31	3	11	41	5
	Part-Part-Whole	38	5	56	92	27	3	15	37	4
b-	Joining	0	33	65	88	15	9	9	47	8
	Part-Part-Whole	0	32	65	89	11	6	21	36	5
c+	Joining	53	11	34	83	41	14	26	6	6
	Part-Part-Whole	51	9	37	71	39	16	29	7	4
c-	Joining	0	37	48	71	16	15	27	13	9
	Part-Part-Whole	0	39	46	65	12	14	38	7	7

Table 16 presents the frequency of these combined strategy categories for each of the four subtraction problem types across the four levels. The data suggest that problem structure is a strong factor in the choice of strategy.

For Separating and Joining, missing addend, the correspondence between problem structure and strategy used is obviously very strong. While the use of the comparative (Matching) strategy with the Comparison problem is not as predominant, the argument for the influence of problem structure on strategy choice is still supported in that the Matching strategy essentially appeared nowhere but in the Comparison problem. For those children who had the Matching strategy within their repertoire of problem-solving processes, the semantic structure of the Comparison problem was strong enough to evoke that strategy. Matching is virtually impossible without manipulatives, which accounts for the virtual absence of Matching at the b- and c- levels.

The data for the Part-Part-Whole, missing addend problem present a less clear picture. The most often used strategy overall was the subtractive one. Yet, the overwhelming numerical difference between the subtractive and additive strategies that occur in the separating problem is not present for this problem. In fact in the c- level more children used an additive strategy than used a subtractive strategy. Reasons for this change to the additive strategy can only be conjectured at this time. A discussion of potential causal factors is not appropriate for this report.

The mental strategies of using number facts and heuristics are not included in this analysis because it was impossible to tell from the coding whether the number fact or heuristic used was additive or subtractive in nature.

Table 16

Number of Responses for Different Subtraction Strategies by Problem and Level

Level	Problem Type	Strategies		
		Subtractive	Additive	Comparative
b+	Separating	55	3	0
	Joining, missing addend	0	40	0
	Comparison	10	17	14
	Part-Part-Whole, missing addend	44	4	0
b-	Separating	43	3	0
	Joining, missing addend	1	46	1
	Comparison	5	21	6
	Part-Part-Whole, missing addend	35	8	0
c+	Separating	62	5	0
	Joining, missing addend	4	62	1
	Comparison	17	20	25
	Part-Part-Whole, missing addend	52	13	0
c-	Separating	39	13	0
	Joining, missing addend	2	57	0
	Comparison	11	28	1
	Part-Part-Whole, missing addend	17	25	0

The "Mental" Strategies

Throughout the first year of instruction that the children receive in class, the memorization of the number facts from 0-10 is encouraged. This fact is reflected in the high use of number facts at the b+ and b- level. In the addition problems, Tasks 1 and 4, Number Fact and Heuristic combined is the most common strategy used to solve the smaller number problems. In the subtraction problems, the "mental" strategies, Number Fact and Heuristic, are the second most commonly used set of strategies for the smaller number problems.

Less Frequently Occurring Strategies

During this fourth interview a number of the possible student behaviors were observed in somewhat isolated instances. The two counting down strategies, Counting Down From and Counting Down To, appeared infrequently. However, in Task 2, Separating problem the Counting Down From strategy was used 8% of the time at the b- level and 12% of the time at the c- level. This is consistent with results from the third interview, showing that children apparently are associating counting down or backwards more often with the separating task than with the comparison or missing addend tasks.

Errors

No task was free of error, although the greater difficulty of the Comparison (Task 5) and the Part-Part-Whole, missing addend problems (Task 3) is reflected in the higher incidence of inappropriate strategy errors (Given Number and Guess). Children's lack of comprehension of the structure of these two problems could be attributed as cause for the cases in which one of the given numbers was supplied as the answer. Overall, miscounting was the most

frequent error. This occurred whether the children used cubes or their fingers or just counted mentally. A summary of the frequency of errors is presented in Table 17.

Secondary Analyses of Data

The data analyses contained in this section concern pupil performance rather than results for specific tasks as in the previous section. The patterns apparent in an individual student's response will be considered. In the first two subsections the relationship between a particular type of strategy or model employed and the correctness of response is examined. In the third section we will examine the consistency of a particular strategy across several tasks.

Relationship of Strategy Employed to Correctness of Response

The basic question of interest in this analysis is, "If a child employed a particular strategy, was the problem also solved correctly?" Data answering this question are presented in Table 18 to 21, which aggregate information by levels b+, b-, c+, and c- respectively.

The results for the following behaviors do not appear in the tables because they are inappropriate to our discussion.

1. Number Fact. A requisite for coding Number Fact is that the child's response must be correct. There were 202 responses coded as Number Fact in b+, 210 in b-, 46 in c+, and 53 in c-.

2. ? or confusion. A requisite for this coding is that the child gives no answer; therefore it could not be coded right or wrong. There were 4 such responses in level b+, 6 in b-, 6 in c+, and 25 in c-.

Table 17

Frequency of Errors Across the Six Problem Tasks

Task	Level	Error Types: Miscount	Forgets data	Use Wrong operation	Given #	Guess	Interview terminated
1 Joining	b+	2	2	0	0	3	0
	b-	1	3	1	0	2	1
	c+	11	1	0	0	1	3
	c-	6	0	0	1	3	11
2 Separating	b+	5	3	4	1	3	0
	b-	4	3	2	0	3	1
	c+	9	3	2	0	6	3
	c-	10	3	0	1	2	11
3 Part-Part-Whole, missing addend	b+	3	6	0	6	5	0
	b-	5	1	3	2	7	1
	c+	17	2	1	4	6	3
	c-	8	3	1	5	13	11
4 Part-Part-Whole	b+	3	3	1	0	3	0
	b-	1	4	0	1	4	1
	c+	13	0	0	0	7	3
	c-	5	2	0	0	5	11
5 Comparison	b+	3	5	3	8	2	1
	b-	0	1	5	6	5	1
	c+	14	1	3	5	6	3
	c-	5	1	3	5	12	11
6 Joining, missing addend	b+	1	1	3	1	3	1
	b-	3	3	1	2	4	1
	c+	5	1	0	0	4	3
	c-	6	1	0	0	5	11

Table 18

Level b+: Number of Children Employing a Strategy and Their Rate of Success

Strategy	Task 1	2	3	4	5	6	Total
CS	3(67%)	-	-	3(100%)	-	-	6(83%)
CL	11(91%)	-	-	15(100%)	-	-	26(96%)
CA	31(97%)	-	-	27(89%)	-	-	58(93%)
F	-	53(87%)	4(80%)	-	8(88%)	0	65(84%)
T	-	0	0	-	0	0	0
MA	-	0	0	-	14(86%)	0	14(86%)
AO	-	0	0	-	3(67%)	25(96%)	28(93%)
DF	-	1(100%)	3(100%)	-	1(100%)	0	5(100%)
UG	-	3(100%)	4(100%)	-	14(86%)	15(87%)	36(89%)
DT	-	1(100%)	0	-	1(0%)	0	2(50%)
HU	5(80%)	2(100%)	2(50%)	4(100%)	2(50%)	2(100%)	17(82%)
GU	3(0%)	3(0%)	5(20%)	3(33%)	2(0%)	3(33%)	19(16%)

[a]Numbers in parentheses give the percentage of the children in that cell who solved the problem task correctly

Table 19

Level b-: Number of Children Employing a Strategy and Their Rate of Success

Strategy	Task 1	2	3	4	5	6	Total
CS	9(89%)	-	-	6(83%)	-	-	15(87%)
CL	9(100%)	-	-	21(95%)	-	-	30(97%)
CA	15(93%)	-	-	11(100%)	-	-	26(96%)
F	-	35(80%)	31(81%)	-	41(100%)	0	70(81%)
T	-	0	0	-	0	0	0
MA	-	0	0	-	6(100%)	1(100%)	7(100%)
AO	-	1(100%)	1(100%)	-	3(100%)	24(88%)	29(90%)
DF	-	8(88%)	4(75%)	-	0	1(0%)	13(77%)
UG	-	2(100%)	7(100%)	-	18(100%)	27(91%)	49(96%)
DT	-	0	0	-	1(100%)	0	1(100%)
HU	8(63%)	3(67%)	2(100%)	5(80%)	3(100%)	0	21(76%)
GU	2(0%)	3(0%)	7(0%)	4(0%)	5(40%)	4(0%)	25(8%)

[a]Numbers in parentheses give the percentage of the children in that cell who solved the problem task correctly

Table 20

Level c+: Number of Children Employing a Strategy and Their Rate of Success

Strategy	Task 1	2	3	4	5	6	Total
CS	14(79%)	-	-	6(67%)	-	-	20(75%)
CL	26(100%)	-	-	29(83%)	-	-	55(91%)
CA	41(80%)	-	-	39(85%)	-	-	80(83%)
F	-	57(79%)	50(70%)	-	14(71%)	4(75%)	125(74%)
T	-	1(100%)	0	-	0	0	1(100%)
MA	-	0	0	-	25(64%)	1(100%)	26(65%)
AO	-	0	1(100%)	-	3(100%)	36(92%)	40(93%)
DF	-	4(25%)	2(50%)	-	2(50%)	0	8(38%)
UG	-	5(80%)	12(67%)	-	17(76%)	26(92%)	60(82%)
DT	-	0	0	-	1(100%)	0	1(100%)
HU	6(100%)	5(100%)	7(86%)	4(50%)	1(0%)	5(100%)	28(86%)
GU	1(0%)	6(0%)	6(0%)	7(0%)	6(0%)	4(0%)	30(0%)

[a]Numbers in parentheses give the percentage of the children in that cell who solved the problem task correctly

Table 21

Level c-: Number of Children Employing a Strategy and Their Rate of Success

Strategy	Task 1	2	3	4	5	6	Total
CS	15(80%)	-	-	14(71%)	-	-	29(76%)
CL	27(89%)	-	-	38(87%)	-	-	65(88%)
CA	16(81%)	-	-	12(75%)	-	-	28(79%)
F	-	25(52%)	11(64%)	-	4(50%)	0	40(55%)
T	-	0	0	-	0	0	0
MA	-	0	0	-	1(0%)	0	1(0%)
AO	-	1(100%)	3(67%)	-	4(75%)	15(80%)	23(78%)
DF	-	12(42%)	4(100%)	-	4(50%)	2(100%)	22(59%)
UG	-	12(92%)	22(77%)	-	24(96%)	42(86%)	100(87%)
DT	-	2(50%)	2(0%)	-	3(33%)	0	7(29%)
HU	9(78%)	9(89%)	4(75%)	7(86%)	4(100%)	5(100%)	38(87%)
GU	3(0%)	2(50%)	13(0%)	5(0%)	12(8%)	5(0%)	40(5%)

[a]Numbers in parentheses give the percentage of the children in that cell who solved the problem task correctly

3. Uncodable. No strategy could be identified, even when the answer was correct. Of the 39 uncodable responses in level b+, 77% were correct; of the 56 uncodable responses in level b-, 75% were correct; of the 35 uncodable responses in level c+, 46% were correct; of the 41 uncodable responses in level c-, 41% were correct.

4. Wrong Operation. If the children used the wrong operation (for example, adding instead of subtracting), the answer was always incorrect. There were 11 responses in level b+ that were coded wrong operation, 12 in b-, 6 in c+, and 4 in c-.

5. Given Number. If a child responded with a number given in the problem, it was always an incorrect answer. There were 16 such responses in level b+, 11 in b-, 9 in c+, and 12 in c-.

The entries in Tables 18-21 present the number of children who used a certain strategy for a certain task. That number is followed by a percentage figure in parentheses, which represents the portion of those children using the strategy who also got the correct answer.

For example, in the example below, of the 3 children who used the counting up from smaller strategy for Task 1, 67% (which is to say, 2 of them) also solved the task correctly.

	Task	
Strategy	1	2
CS	3(67%)	-

In the example, a dash appears on the CS cell for Task 2. A dash indicates the strategy would be inappropriate for this task. In the example, CS is an addition strategy and thus was not coded for Task 2, a subtraction problem.

There is no clearcut pattern indicating that one particular strategy appears to be more successful than any other. This reflects the fact that errors that occur are randomly distributed across tasks and levels.

Relationship of Model Used to Correctness of Response

We also investigated the relationship between a particular modeling behavior and the rate of correct responses. Tables 22-25 present the results. In the Model category the possible responses were cubes, fingers, no action, other (physical), or a combination of cubes and fingers. Uncodable model responses, confused responses, and combination of models other than cubes and fingers were not considered in the tabulation of these results.

The tables present the number of children who used a particular model for each task and the percentage of those children whose answer to the task was correct.

In general, the data in the "Total" columns suggest that the children performed at about the same level of accuracy regardless of what model they used.

Consistency of Student Response

We also investigated whether a child who exhibited a particular response on a problem task would tend to exhibit that behavior on another task. More specifically, does a child show a consistent pattern of response, exhibiting the same behavior every time it is appropriate? Such consistency of behavior could indicate a child's interpretation of the operation of addition or subtraction. If, in a given level, a child used an additive strategy consistently over all four subtraction tasks, such consistency could indicate that the child has formed an interpretation of subtraction that is independent of the structure of a problem.

Table 22

Level b+: Number of Children Employing a Model and Their Rate of Success

	Task						
Model	1	2	3	4	5	6	Total
Cubes alone	36(97%)[a]	48(79%)	45(69%)	38(89%)	34(71%)	34(85%)	235(81%)
Fingers alone	6(100%)	8(100%)	8(88%)	5(100%)	9(78%)	5(100%)	41(93%)
Cubes and Fingers	0	0	0	0	0	0	0
No action	57(88%)	43(84%)	45(82%)	56(95%)	53(79%)	59(93%)	313(87%)
Other	0	0	0	0	0	0	0

[a]Numbers in parentheses give the percentage of the children in that cell who solved the problem task correctly.

Table 23

Level b-: Number of Children Employing a Model and Their Rate of Success

	Task						
Model	1	2	3	4	5	6	Total
Cubes alone	NA	NA	NA	NA	NA	NA	NA
Fingers alone	33(88%)[a]	42(74%)	39(77%)	32(97%)	32(69%)	35(83%)	213(81%)
Cubes and Fingers	NA	NA	NA	NA	NA	NA	NA
No action	65(91%)	56(88%)	58(78%)	65(88%)	63(84%)	63(89%)	370(86%)
Other	0	0	0	1(100%)	0	0	1(100%)

[a]Numbers in parentheses give the percentage of the children in that cell who solved the problem task correctly.

Note: NA indicates the strategy is not applicable to this task.

Table 24

Level c+: Number of Children Employing a Model and Their Rate of Success

	Task						
Model	1	2	3	4	5	6	Total
Cubes alone	51(84%)[a]	58(79%)	53(66%)	50(82%)	51(59%)	43(84%)	306(75%)
Fingers alone	9(78%)	7(57%)	6(67%)	8(63%)	8(63%)	10(90%)	48(71%)
Cubes and Fingers	2(100%)	0	0	1(100%)	1(100%)	1(100%)	5(100%)
No action	34(91%)	29(66%)	35(49%)	37(65%)	35(63%)	42(83%)	212(70%)
Other	0	1(0%)	0	0	0	0	1(0%)

[a]Numbers in parentheses give the percentage of the children in that cell who solved the problem task correctly.

Table 25

Level c-: Number of Children Employing a Model and Their Rate of Success

	Task						
Model	1	2	3	4	5	6	Total
Cubes alone	NA	NA	NA	NA	NA	NA	NA
Fingers alone	36(86%)	38(47%)	36(58%)	37(81%)	24(67%)	40(78%)	211(70%)
Cubes and Fingers	NA	NA	NA	NA	NA	NA	NA
No action	48(79%)	40(78%)	45(53%)	46(70%)	53(55%)	44(80%)	276(68%)
Other	2(50%)	0	0	1(100%)	1(100%)	1(0%)	5(60%)

[a]Numbers in parentheses give the percentage of the children in that cell who solved the problem task correctly.

Note: NA indicates the strategy is not applicable to this task.

Consistency is examined in two ways. In the first, behavior was summarized across all the tasks administered within a specific level. In the second analysis, consistency was considered for a single task across all the levels in which it appeared. The total population of 99 subjects was used in this analysis. In addition to considering use of model, correctness, and strategies, this analysis treated several combined strategies. The combined strategies represent similar patterns of thinking. The following combined strategies have been created for this analysis:

CE - The student responded either CL (Counts Up from Larger) or CS (Counts Up from Smaller).

SEP- The student responded either F (Separates From) or T (Separates To).

CDT- The student responded either DF (Counts Down From) or DT (Counts Down To).

SF - The student responded either F (Separates From) or DF (Counts Down From).

AD - The student responded either AO (Add On) or UG (Counts Up from Given).

ST - The student responded either T (Separates To) or DT (Counts Down To).

ADV- The student responded either with #F (Number Fact) or HU (Heuristic).

In general, the results show the following:

1. Within a level, once the children decide to use cubes or fingers as a model, they are fairly consistent in that use. They are also consistent in the use of cubes across tasks.

2. Overall, the children are somewhat consistent in the use of strategies for addition tasks. However, there is little consistency in the subtraction tasks across a level, which is to be expected if, as indicated previously in this report, problem structure is a major determining factor in children's

choice of strategy.

3. Children were more consistent in choice of strategy for the Separating and the Part-Part-Whole, missing addend tasks across levels than for the Comparison and the Joining, missing addend tasks.

The cases where children were consistent, that is, where 3 or more children gave a response the maximum number of times possible, are detailed in Tables 26 and 27.

Conclusion

This is the fourth in a series of reports on the data from the individual interviews for the Coordinated Study. Each report contains data for only one round of interviewing, and is not concerned with results or changes across time. The longitudinal findings will be presented in separate reports. For previous and subsequent reports in the individual interview series and for additional information and reports concerning the longitudinal study, contact the Mathematics Work Group at the Wisconsin Research and Development Center for Individualized Schooling, Madison, Wisconsin.

Table 26

Number of Children Who Gave Response Maximum

Number of Times Across Tasks by Level

Model or strategy	Maximum responses possible	Level			
		b+	b-	c+	c-
Cubes	6	17	NA	29	NA
Fingers	6	-	15	-	13
No action	6	24	39	14	24
Correct	6	42	41	25	18
CS	2	-	-	-	8
CL	2	5	6	15	21
CA	2	19	4	30	7
CE	2	6	10	25	35
UG	4	-	-	-	6
AD	4	-	-	-	6
#F	6	6	10	-	-
ADV	6	7	12	-	5

Note: NA indicates the strategy is not applicable to particular task.

dash (-) - The number of children responding the maximum number of times was less than three.

Table 27

Number of Children Who Gave Response Maximum

Number of Times Across Levels by Task

Model or strategy	Maximum responses possible	Task					
		1	2	3	4	5	6
Cubes	2	28	36	33	32	29	28
No action	4	25	17	19	23	26	27
Correct	4	54	33	28	44	28	51
F	4	NA	12	6	NA	-	-
SEP	4	NA	12	6	NA	-	-
SF	4	NA	21	8	NA	-	-
AO	4	NA	-	-	NA	-	5
AD	4	NA	-	-	NA	-	19
#F	4	4	3	-	4	4	5
ADV	4	8	5	4	7	6	8

NA - The strategy is not applicable to particular task.

dash (-) - The number of children responding the maximum number of times possible was less than 3.

Reference Notes

1. Kouba, V.L. & Moser, J.M. Development and validation of curriculum units related to initial sentence writing (Technical Report No. 522) Madison: Wisconsin Research and Development Center for Individualized Schooling, October 1979.

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3. Moser, J.M. Young children's representations of addition and subtraction problems (Theoretical Paper No. 74) Madison: Wisconsin Research and Development Center for Individualized Schooling, May 1979.

4. Carpenter, T.P. & Moser, J.M. An investigation of the learning of addition and subtraction (Theoretical Paper No. 79) Madison: Wisconsin Research and Development Center for Individualized Schooling, November 1979.

5. Martin, C. & Moser, J.M. Interviewer training procedures (Working Paper) Madison: Wisconsin Research and Development Center for Individualized Schooling, 1980.

6. Cookson, C. & Moser, J.M. Coordinated study individual interview procedures (Working Paper) Madison: Wisconsin Research and Development Center for Individualized Schooling, 1980.

7. Carpenter, T.P., Hiebert, J. & Moser, J.M. The effect of problem structure on first-graders' initial solution processes for simple addition and subtraction problems (Technical Report No. 516) Madison: Wisconsin Research and Development Center for Individualized Schooling, 1979.

References

Gibb, E.G. Children's thinking in the process of subtraction. Journal of Experimental Education, 1956, 25, 71-80.

Romberg, T.A., Harvey, J.G., Moser, J.M. & Montgomery, M.E. Developing Mathematical Processes. Chicago: Rand McNally and Co., 1974.

APPENDIX A

PROBLEM TASKS BY LEVEL

B+

1. Addition - simple joining

Sheri had _____ plastic spoons. Her brother gave her _____ more plastic spoons. How many plastic spoons did Sheri have altogether?

B+

2. Subtraction - simple separating

Bradley had _____ caps. He gave _____ to Louise. How many caps did Bradley have left?

B+

3. Subtraction - part, part, whole missing addend

There are _____ butterflies in a collection. _____ are big and the rest are little. How many little butterflies are there in the collection?

B+

4. Addition - part, part, whole

Rebecca has _____ chocolate cupcakes. She also has _____ white cupcakes. How many cupcakes does Rebecca have altogether?

B+

5. Subtraction - comparison

Joseph has _____ dimes. His friend Sue has _____ dimes. How many more dimes does Larry have than Joseph?

B+

6. Subtraction - simple joining missing addend

Lora had _____ shells. How many more shells does she have to put with them so she has _____ shells altogether?

B-

1. Addition - simple joining

James had _____ toy cars. His father gave him _____ more toy cars. How many toy cars did James have altogether?

B-

2. Subtraction - simple separating

Marie had _____ candles. She gave _____ candles to Fran. How many candles did Marie have left?

B-

3. Subtraction - part, part, whole missing addend

There are _____ jars of paint. _____ jars are red and the rest are blue. How many jars of blue paint are there?

B-

4. Addition - part, part, whole

Carol has _____ old shirts. She also has _____ new shirts. How many shirts does Carol have altogether?

B-

5. Subtraction - comparison

Patrick has _____ fish. His sister Jill has _____ fish. How many more fish does Jill have than Patrick?

B-

6. Subtraction - simple joining missing addend

Kathy has _____ M & M's. How many more M & M's does she have to put with them so she has _____ M & M's altogether?

C+

1. Addition - simple joining

Norman had _____ books. His friend gave him _____ more books. How many books did Norman have altogether?

C+

2. Subtraction - simple separating

Jeanne had _____ buttons, She gave _____ buttons to Evelyn, How many buttons did Jeanne have left?

C+

3. Subtraction - part, part- whole missing addend

There are _____ children swimming. _____ are boys and the rest are girls. How many girls are swimming?

C+

4. Addition - part, part, whole

The dog has _____ dog biscuits. He also has _____ dog biscuits. How many dog biscuits does the dog have altogether?

C+

5. Subtraction - comparison

Ellen has _____ holloween candies. Her friend Greg has _____ holloween candies. How many more candies does Greg have than Ellen?

C+

6. Subtraction - simple joining missing addend

Robert has _____ caterpillars. How many more caterpillars does he have to put with them so he has _____ caterpillars altogether?

C-

1. Addition - simple joining

Dennis had _____ marbles. His mother gave him _____ more marbles. How many marbles did Dennis have altogether?

C-

2. Subtraction - simple separating

Dawn had _____ toy airplanes. She gave _____ of them to Sharon. How many toy airplanes did Dawn have left?

C-

3. Subtraction - part, part, whole missing addend

There are _____ monkeys in a cage. _____ are on the ground and the rest are in the tree. How many monkeys are in the tree?

C-

4. Addition - part, part, whole

Peter has _____ white socks. He also has _____ blue socks. How many socks does Peter have altogether?

C-

5. Subtraction - comparison

Marian had _____ apples. Her friend Sally had _____ apples. How many more apples does Sally have than Marian?

C-

6. Subtraction - simple joining missing addend

Wayne has _____ bottle caps. How many more bottle caps does he have to put with them so he has _____ bottle caps altogether?

APPENDIX B

INDIVIDUAL STUDENT PROFILES

101	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y #F –	N Y HU –	N Y #F –	N Y #F –	N N GU –	N Y #F –
b-	N Y #F –	N N GU –	N Y #F –	N Y #F –	N Y #F –	N Y #F –
c+	N Y CL –	N N GU –	F Y DF –	F Y CL –	F Y UG –	F Y UG –
c-	F Y CL –	N Y HU –	N N UN –	F Y CL –	F N GI GI	F N UG M
102	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Task 6**
b+	C Y CA –	C Y F –	C N F F	C Y CA –	C N GI GI	C N OP O
b-	N Y #F –	N N GU –	N N GU –	N Y #F –	N N OP O	N N GU F
c+	C Y CA –	C Y F –	C N F M	C Y CA –	C N GI GI	C Y F –
c-	F Y CA –	F Y F –	N N GU –	N N GU –	N N GI GI	N Y HU –
103	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Task 6**
b+	N N CS F	C N F F	N Y #F –	N N GU F	F Y UG –	C N UG –
b-	F Y CA –	F N F F	F Y F –	F Y CL –	N N GU –	F Y UG –
c+	C Y CS –	C Y F –	C Y F –	C N CA M	C Y F –	C Y AO –
c-	F Y CS –	F N F –	F N GU –	F Y CL –	– ? ? –	F N UG –
104	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Task 6**
b+	C Y CA –	C Y F –	C Y F –	C Y CA –	C Y AO –	N Y UG –
b-	N Y CS –	N Y DF –	F N F M	N Y CS –	N Y UG –	N Y UG –
c+	C Y CA –	C Y F –	C Y F –	C N CA M	C Y AO –	C N AO M
c-	F Y CA –	F Y F –	– ? ? –	F N UN –	N Y UG –	F N AO M

105	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N N UN -	N Y #F -	N Y #F -	N Y UN -	N Y #F -
b-	F Y CS -	N Y #F -	N Y #F -	N Y #F -	N Y UG -	N N GU -
c+	N N GU -	N Y #F -	C N F M	N N GU -	N N GU -	N N GU -
c-						

106	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y DF -	N Y DF -	N N GU F	N Y UG -	N Y UG -
b-	N Y #F -	F Y F -	F Y F -	N Y #F -	N Y UG -	N Y UG -
c+	N N CS M	O N F M	C N F M	N N CS M	F Y UG -	N N GU -
c-						

107	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N N GU F	N N GU F	- ? ? -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N N OP O	N Y #F -	N Y UG -	N Y #F -
c+	N Y CL -	N N DF M	- ? ? -	N Y CL -	- ? ? -	N Y #F -
c-						

108	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	N N GU -	C Y CA -	C Y MA -	C Y AO -
b-	F Y UN -	F N F F	F Y UN -	F Y S -	F Y UG -	F Y AO -
c+	C Y CA -	C N F -	C N GI GI	C N CA M	C N MA -	C Y AO -
c-	F N CA -	F N F -	F N GU -	F N CA M	F N AO -	F N AO -

109	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C Y F -	C Y CA -	N N GI GI	C Y AO -
b-	F Y #F -	F Y F -	F Y F -	F Y CL -	N N GI GI	F N AO -
c+	C N CA M	C N F M	C N F M	C Y CA -	N N GI GI	C N UN -
c-	F Y CA -	F N UN -	- ? ? -	F Y CA -	N N GI GI	F N UN -
110	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Task 6**
b+	F Y CA -	F Y F -	F Y F -	F Y CA -	F Y MA -	F Y AO -
b-	F Y CA -	F Y F -	F Y F -	F Y CA -	F Y MA -	F Y AO -
c+	F Y CL -	C N F M	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	F Y CA -	F Y F -	F Y F -	F Y CL -	F N MA -	F Y UG -
111	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Task 6**
b+	N Y #F -	C Y F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	F Y F -	N Y #F -	F Y MA -	N Y #F -
c+	C Y HU -	C Y T -	C N F M	C Y CS -	C N MA M	C Y AO -
c-	N Y #F -	F Y HU -	F Y F -	F Y CS -	- ? ? -	N Y #F -
112	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Task 6**
b+	N Y #F -	C Y F -	C Y F -	N Y #F -	N Y #F -	N Y HU -
b-	F Y CL -	F Y F -	F Y F -	F Y CL -	F Y UG -	F N AO F
c+	C Y CA -	C Y F -	C Y F -	C N CL M	C N MA M	C Y MA -
c-	F Y CL -	F Y F -	F N F M	F Y CL -	F Y F -	F Y AO -

113	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	C N F F	N Y #F -	C Y MA -	N Y #F -
b-	N Y #F -	N N UN -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	C Y CA -	C Y F -	C N F M	N Y CA -	C Y UG -	N Y UG -
c-	N Y #F -	N N GU -	N Y #F -	N Y CL -	N Y UG -	N N UG M

114	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	C Y F -	C Y CA -	N Y #F -	C Y AO -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C N AO F
c-	N Y #F -	- ? ? -	F ? ? -	F Y CA -	- ? ? -	F Y AO -

115	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	N Y #F -	F N F -	N Y #F -	- ? ? -	N Y UN -
b-	F Y UN -	N Y UN -	N Y DF -	N Y UN -	N Y UN -	F Y AO -
c+	F Y CS -	F Y UN -	- ? ? -	F N CL M	F N UN -	F N UN -
c-						

116	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y F -	C N AO -
b-	F Y CS -	F Y F -	F Y F -	F Y HU -	F Y F -	F Y AO -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y F -	C Y F -
c-	F Y CS -	F N F M	F Y F -	F Y CA -	F N F M	N N GU -

117	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	N Y #F -	N Y #F -	N N GU -	N Y HU -	N Y #F -	N Y HU -
c-	N Y HU -	N Y HU -	N Y #F -	N Y HU -	N Y #F -	N Y HU -

118	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y UG -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N Y UG -	N Y CL -	N Y #F -	N Y #F -
c+	N Y CL -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -

119	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C N F M	C Y F -	C Y CA -	N N GI GI	C Y AO -
b-	F Y CA -	F Y F -	F Y F -	F Y CA -	F N OP O	F Y AO -
c+	C N CA M	C N F M	C N F M	C N CA M	C N GI GI	C N F M
c-						

120	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	F Y CA -	F Y F -	F Y F -	N Y #F -	F Y UN -	F Y UN -
b-	F N GU -	F Y F -	F Y UN -	F Y UN -	N Y HU -	N Y UN -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	N N HU -	N Y UN -
c-	N N CA -	N Y #F -	N Y #F -	N N UN -	N N GU -	N Y UN -

121	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CL -	C Y F -	C Y F -	C Y CL -	C N GI GI	N Y #F -
b-	N Y #F -	F Y DF -	F Y DF -	N N GI GI	N N GI GI	N Y #F -
c+	C Y CA -	C Y F -	C Y F -	N N GU -	C N F -	C Y AO -
c-	F Y CL -	F N DF -	F Y UG -	F Y CL -	F Y AO -	F Y UG -

123	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y UN -	N Y #F -	N N UG M
b-	N Y #F -	N N UN -	N Y #F -	N Y #F -	N Y UG -	N Y #F -
c+	C Y CA -	C Y F -	N Y UG -	N Y CS -	C N UG M	N Y HU -
c-	N Y HU -	N Y UG -	N Y UG -	N Y CL -	N Y UN -	F Y UG -

124	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	C N F M	C Y CA -	C Y MA -	C Y AO -
b-	F Y CA -	N Y #F -	N Y #F -	N Y #F -	N N GU F	N Y UN -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	O N CS M	N Y HU -	F Y AO -	O Y CS -	O Y DT -	F Y UG -

125	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	F Y F -	F Y F -	F Y CS -	F N GI GI	N Y #F -
b-	F Y CA -	F Y F -	F N F -	F Y CS -	F N UN -	N Y #F -
c+	C N CA M	C N OP O	C N F M	C Y CA -	C N UN -	C N UN -
c-						

127	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C Y F -	C Y CL -	N Y #F -	C Y AO -
b-	F Y CA -	F Y F -	F Y F -	F Y CS -	F Y F -	F Y UN -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	F Y CL -	F Y DF -	F Y DF -	F N UN -	F N UN -	F Y AO -

128	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C N GI GI	C Y CS -	F Y UG -	F Y UG -
b-	N Y #F -	F N F M	N N OP O	N Y #F -	F Y UN -	F Y AO -
c+	C Y CA -	C Y F -	N N UN -	C Y CA -	F Y UG -	F Y UG -
c-	F Y CS -	F Y DT -	N N GU -	F Y CS -	F N DT F	F N UN -

129	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y UN -	N N OP O	N N GU -	C Y CA -	C Y MA -	C Y AO -
b-	F Y CA -	F N OP O	F Y UN -	N Y UN -	F Y UG -	F Y UG -
c+	N Y CS -	C Y F -	N N GU -	C Y CL -	C Y AO -	C N AO M
c-	F Y CS -	F Y UG -	N N UN -	N N CS -	F Y UG -	F Y UG -

130	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y UG -	N Y #F -	N Y #F -	N N HU F	N Y #F -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	N Y CL -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c-	N Y #F -	N N UN -	N N UG -	N Y #F -	N Y #F -	F Y UG -

131	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y HU -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y UN -
b-	F Y UN -	F Y F -	N Y #F -	N Y CL -	F Y MA -	F Y UG -
c+	C Y CA -	C N F -	C Y F -	C Y CA -	C N MA M	C Y AO -
c-	F N CA -	F N DF -	F N GI GI	F N CA -	N Y UN -	F Y UN -

132	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y UN -	N Y #F -	N Y UG -	N Y CL -	N N UG F	N Y #F -
b-	N Y #F -	F N DF -	N N DF F	N Y #F -	N Y #F -	N Y #F -
c+	C Y CL -	N N GU -	N Y #F -	N Y #F -	N Y #F -	N Y HU -
c-	N Y #F -	F N DF -	F Y UG -	F Y CL -	N Y HU -	N Y #F -

133	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C N F F	C N UN -	C N CA M	C N GI GI	C Y UN -
b-	F Y CA -	F Y F -	F N GU -	F Y CA -	N N GI GI	F Y AO -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	N N GI GI	C Y AO -
c-	F Y CA -	F N GI GI	N N GU -	N Y CL -	N N GI GI	N N UN -

134	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N N UN -	N Y UN -	N N UN -	C N UN -		
b-						
c+						
c-						

135	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C Y F -	C Y CA -	N N UG F	N Y #F -
b-	N Y HU -	N Y UN -	N Y #F -	F Y CA -	F N UN -	N N DF M
c+	C N CA M	C N F M	C Y F -	C Y CA -	C N OP O	C Y F -
c-	F Y CS -	F Y F -	F Y F -	F N CS -	F Y UN -	F Y UG -

136	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	F Y CA -	F Y F -	N N GI GI	N Y #F -	F Y F -	C Y AO -
b-	N Y #F -	F Y UN -	N N UN -	N Y UN -	N Y #F -	N Y UN -
c+	N Y CL -	C Y F -	C Y F -	N N GU -	C Y F -	C Y AO -
c-	N Y CL -	F Y F -	F N F -	F Y CL -	F Y DF -	N Y UN -

137	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y HU -	C Y F -	C Y F -	C Y S -	C Y F -	C Y UN -
b-	N Y #F -	F Y F -	F Y F -	N Y CL -	F Y F -	F Y AO -
c+	C Y CL -	C Y F -	C Y AO -	C Y CL -	C Y F -	C Y AO -
c-	N Y CL -	N Y DF -	F Y UG -	F Y CL -	F Y UG -	F Y UG -

139	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	F Y HU -	F Y F -	C N GU -	C Y UN -	F Y UN -	C Y #F -
b-	F N HU F	F Y F -	F Y F -	F Y S -	F Y AO -	F Y AO -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	F Y CS -	F N F -	F Y UN -	F N CS F	F Y UG -	F Y UG -

141	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y CL -	N N UN -	N Y UN -
b-	N Y #F -	N Y #F -	N Y UN -	N Y CL -	N N GU -	N Y #F -
c+	N Y UN -	N N GU -	C N UN -	C N UN -	N Y UN -	N Y UG -
c-	N Y CL -	N N UN -	N Y UG -	N N CL -	N N UN -	N N GU -

142	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C N CA M	C N OP O	C N GI GI	C Y CA -	C N OP O	C N GI GI
b-	F Y CS -	F N OP O	F N GU -	F Y CA -	F N GI GI	F Y AO -
c+						
c-						

143	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C Y F -	N Y #F -	C Y MA -	C Y AO -
b-	F Y CS -	F Y F -	F Y F -	O Y CS -	F Y MA -	F Y AO -
c+	C N MA M	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	F Y CL -	F N F F	F Y F -	F Y CL -	F Y AO -	F Y AO -

144	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	F Y CA -	F Y F O	F Y F -	F Y #F -	F Y F -	F Y AO -
b-	F Y CA -	F Y AO -	F Y AO -	F Y #F -	N Y UG -	F Y AO -
c+	F Y CS -	F N OP O	F Y F -	F Y CL -	N Y UG -	C Y AO -
c-	F N CS M	F N F M	F Y #F -	N N CL M	N N F M	N Y UG -

147	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	C Y F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	F Y F -	F Y CL -	N Y UG -	F Y UG -
c+	N Y #F -	C Y F -	N N GI GI	F N UN -	C N F M	N Y UN -
c-	N Y #F -	F Y F -	F Y UG -	N Y HU -	F Y UG -	N Y UG -

148	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	N Y HU -	N Y #F -	N N UG F	N N GU -	N N UG M	N Y UG -
c-	N Y CL -	N Y UN -	N Y UG -	N Y #F -	N Y UG -	N Y UG -

151	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	N N UN -	F Y CS -	N Y UN -	N N OP O
b-	F Y CS -	F Y F -	N N GU -	N N GU -	F N UN -	N N GU -
c+	F N CA M	N N GU -	N N GU -	F N UN -	N N GU -	C N UN -
c-						

152	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y S -	C Y F -	C N F F	C Y S -	C N MA M	C Y AO -
b-	F Y CA -	F Y F -	F N F M	F N UN -	F Y AO -	F Y AO -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C N MA M	C Y AO -
c-	F Y CA -	F N F M	F N UN -	F Y CA -	- ? ? -	F Y AO -

153	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C Y F -	C Y CA -	N Y UG -	N Y UG -
b-	N N CS F	F Y F -	F Y F -	F Y S -	F N GI GI	F Y AO -
c+	C Y CA -	F Y UG -	C N F M	C Y CA -	C N MA M	C Y UN -
c-	N Y CL -	F N F -	F Y AO -	N Y CL -	N N GU -	F N AO F

154	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C N F M	C Y UN -	C Y CA -	C N UN -	C Y #F -
b-	N Y #F -	N Y #F -	N N OP O	N Y #F -	N Y #F -	N Y #F -
c+	C Y CA -	C Y F -	C N UN -	C Y CS -	C Y F -	C Y AO -
c-	F Y CL -	F Y UN -	F N GU -	F Y CL -	F N UN -	F Y UG -

155	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N N GU -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	N N CS M	N Y DF -	N N DF M	N Y CS -	N Y UG -	N Y UG -
c-	N Y CS -	N Y DF -	N N UG M	N N CL M	N Y UG -	N N GU -

158	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CL -	C Y F -	C Y F -	C Y CL -	C Y MA -	C Y AO -
b-	F Y CA -	F Y F -	N N UN -	F Y CA -	F Y UN -	F Y AO -
c+	C Y CL -	C Y F -	C Y F -	C Y CL -	C N MA M	C Y AO -
c-	F Y HU -	N Y GU -	N N GU -	F Y CL -	N Y HU -	F Y UG -

159	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y CL -	N Y UG -	F Y UG -	N Y HU -	F Y DF -	N Y #F -
b-	N Y CL -	N Y DF -	N Y UG -	N Y CL -	F Y UG -	F Y UG -
c+	F Y CL -	F N DF -	F N UG -	N N GU -	F N UN -	F Y UG -
c-						

160	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N N OP O	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y DF -	N Y #F -	N Y #F -	N Y #F -	N Y UG -
c+	N Y CL -	N Y UG -	N Y HU -	N Y CL -	N Y UG -	N Y UG -
c-	N Y CL -	N Y UG -	N Y UG -	N Y CL -	N Y UG -	N Y UG -

162	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	F Y DF -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	F Y F -	F Y F -	N N GU F	N Y #F -	N Y UN -
c+	N Y CL -	N Y UG -	N Y UG -	N Y #F -	C Y UN -	F Y UG -
c-	N Y CL -	N Y UN -	N Y UG -	F Y CL -	N Y UG -	N Y UG -

163	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -

164	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y CL -	C Y F -	N Y #F -	N Y #F -	N Y #F -	N Y UG -
b-	N Y #F -	N Y #F -	N Y #F -	N Y CL -	N Y UG -	N Y UG -
c+	F Y CL -	C Y F -	C N F M	N Y CL -	C Y F -	C Y AO -
c-	N N CL M	F Y AO -	F N AO M	F Y CL -	N N GU -	F Y AO -

165	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C N F M	C N F F	C Y CA -	- ? ? -	C N OP O
b-	F Y S -	F N F F	F ? ? -	F Y CA -	F N OP O	F N OP O
c+						
c-						

166	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	C Y F -	N Y #F -	N Y #F -	N N GU -
b-	N Y #F -	N Y HU -	N Y UG -	F Y CL -	N Y #F -	N Y #F -
c+	N Y CL -	C Y F -	N N OP O	N N CL M	C Y MA -	F Y UG -
c-	N Y CL -	F N F M	N N OP O	N Y CL -	N N OP O	F Y UG -

167	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N N HU -	C Y F -	C Y F -	N Y HU -	N N DT M	N Y #F -
b-	N Y #F -	F N F M	F Y F -	N N HU -	F Y F -	N N UG F
c+	C Y CL -	C Y F -	C N F M	C Y CL -	C N MA M	N N UN -
c-	N N UN -	N N DF F	N Y UG -	N Y CL -	F N DF -	F Y DF -

168	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y DT -	N Y DF -	N Y CL -	N N OP O	N Y #F -
b-	N Y CS -	N Y #F -	N Y #F -	N N CL F	N N OP O	N Y #F -
c+	N Y CL -	C N F F	N Y UG -	N Y CL -	N N OP O	N Y UG -
c-	N Y CL -	N Y UG -	F Y UG -	N N CL F	N N OP O	N Y UG -

169	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y CL -	N N OP O	N Y UG -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N N OP O	F Y AO -
c+	C Y CS -	C Y F -	C Y F -	C Y CL -	C N OP O	F Y UG -
c-	F Y CL -	F Y F -	F Y F -	F Y CL -	F N OP O	F Y UG -

170	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C N OP O	C N GU -	C Y S -	C Y UN -	C Y AO -
b-	F N CA M	F Y F -	N N GU -	F Y CL -	F N UN -	N Y UN -
c+	C N CA M	C Y F -	N N UN -	N N CS M	N N GU -	N Y UN -
c-	N N GU -	N Y #F -	N N GU -	N N GU -	N N GU -	N N GU -

171	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y CL -	N Y #F -	C Y F -	N Y CL -	C Y UG -	N Y UG -
b-	N Y CL -	N Y UG -	N Y #F -	N Y CL -	N Y DT -	N Y #F -
c+	N Y CL -	C Y F -	N Y UG -	C N CA M	N N GU -	N Y UG -
c-	N N HU -	N Y UG -	N Y UG -	N N HU -	- ? ? -	- ? ? -

93

172	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y UG -	N Y UN -
b-	N Y #F -	N Y #F -	N Y UG -	N Y #F -	N Y #F -	N Y #F -
c+	N Y CL -	C N F -	F Y UG -	N Y CL -	N N DF F	N Y UG -
c-	F Y CS -	N Y DF -	F Y UG -	N Y CS -	N Y UG -	N Y UG -

173	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	N Y #F -	N Y UN -	N Y UN -	N Y #F -
b-	N Y #F -	N Y #F -	N Y DF -	F Y CA -	N Y UG -	N Y #F -
c+	N Y CA -	N Y UN -	N N UG M	N Y CL -	N N UG M	N Y UG -
c-	N Y #F -	N N UN -	N N UG M	N N CS M	N N DT M	N N UG M

175	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N N UN -	N N GI GI	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N N GI GI	N Y #F -	N Y #F -	N Y #F -
c+	F Y CS -	N N DF -	N N GI GI	N N GU -	N Y UN -	N Y #F -
c-	N Y #F -	F N DF -	N N GI GI	N Y CS -	N Y UG -	N Y UG -

176	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y UN -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	C Y CS -	N Y HU -	C Y UG -	C Y CL -	C Y UG -	N Y UG -
c-	N Y HU -	N Y UG -	N Y #F -	N N CL M	N N UG M	O N UG M

177	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N N CL M	C Y F -	C N F M	N Y #F -	C Y MA -	C Y AO -
b-	N Y #F -	F N F M	F N F M	N Y CL -	N Y #F -	N Y UG -
c+	C Y CA -	C Y F -	C Y F -	C Y CL -	C N MA -	N Y UG -
c-	F Y CL -	F Y F -	F N UN -	N Y CL -	N N UN -	N Y UG -

301	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N N GU -	N Y #F -	N Y UN -	N Y #F -	N Y UN -	C Y AO -
b-	N Y #F -	N Y DF -	N Y UN -	N Y #F -	N Y #F -	N Y #F -
c+	C Y CA -	C N UN -	C N F M	N Y UN -	N Y UN -	N Y #F -
c-	F Y CA -	F N DF M	N Y UN -	- ? ? -	N N GU -	N Y UN -

302	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	N Y #F -	N N HU F	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N N HU -	N N GU -	N Y CL -	N Y UG -	N Y UG -
c+	C Y CL -	C N F M	C Y F -	C N CL M	N Y DF -	C Y AO -
c-	F N CL M	- ? ? -	- ? ? -	F Y CL -	N Y DF -	F Y AO -

303	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	N Y #F -	N Y HU -	N Y HU -	N Y #F -	N Y #F -	N Y #F -
c-	N Y #F -	N Y UN -	N Y #F -	N Y #F -	N Y #F -	N Y #F -

304	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA –	C N F M	C Y F –	C Y S –	C Y MA –	C Y AO –
b–	N Y CL –	N Y DF –	N Y UG –	N N CS M	– ? ? –	N Y UG –
c+	C Y CA –	C Y F –	C Y F –	C Y CA –	C Y MA –	C Y AO –
c–	F Y CA –	F Y F –	N N GU –	F Y CA –	F Y UG –	F N GU –

305	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F –	N Y UG –	N Y #F –	N Y CL –	N Y UG –	N Y UG –
b–	N Y CS –	N Y #F –	N Y #F –	N Y #F –	N Y UG –	N Y UG –
c+	N Y CL –	N Y UG –	N Y HU –	N Y CL –	N Y UG –	N Y HU –
c–	N Y HU –	N Y UG –	N Y HU –	N Y CL –	N Y UG –	N Y UG –

306	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F –	C Y F –	C N GI GI	C N CA M	C N GI GI	C Y AO –
b–	N Y #F –	F Y F –	F N F M	F Y CA –	F N UN –	F N GI GI
c+	C Y CA –	C Y F –	C N F M	C Y CA –	C N GI GI	C Y AO –
c–	F N GI GI	F Y F –	F ? ? –	F Y CA –	N N GU –	F ? ? –

307	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F –	C Y F –	N Y #F –	N Y CL –	N Y UG –	N N GU F
b–	N Y HU –	N Y #F –	F Y F –	N Y UN –	N Y UN –	N Y UG –
c+	C Y CA –	N N GU F	C Y F –	F Y CA –	C Y MA –	N Y UG –
c–	N Y CL –	F N UN –	F N DT M	N Y HU –	N N GI GI	N Y UG –

308	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N N GU -	N N GU -	C Y F -	N Y #F -	N Y UN -	N Y #F -
b-	N Y CL -	N N UN -	N Y #F -	N Y CL -	N Y UN -	N N UG M
c+	N Y #F -	N Y #F -	C Y F -	C Y CA -	N Y UG -	N Y UG -
c-	N Y CS -	N N HU -	N N DT F	N N GU -	N Y #F -	N Y HU -

309	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
b-	F Y CA -	F Y F -	F Y F -	F Y S -	F ? ? -	F N AO M
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	F Y CA -	- ? ? -	F N F M	- ? ? -	N Y GU -	F Y AO -

310	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C N F M	C Y CA -	C Y MA -	C Y UG -
b-	F N OP O	F Y F -	F Y F -	F Y CA -	F Y AO -	F Y AO -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	F Y CL -	F Y DF -	F Y DF -	F Y CA -	F Y F -	F Y AO -

311	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y CL -	N Y #F -	N Y #F -	N Y #F -	N N GU -	N Y #F -
b-	N Y CL -	N Y #F -	N Y UG -	N Y UN -	N Y UG -	N Y #F -
c+	N Y CL -	C Y F -	N Y HU -	N Y CL -	C N F M	N Y UG -
c-	N Y CL -	N Y UG -	N N UG F	N Y CL -	N Y UG -	N Y UG -

312	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y CL –	N Y #F –	C Y F –	N Y #F –	C Y UN –	N Y #F –
b-	N Y #F –	N Y #F –	N Y #F –	N Y #F –	N Y #F –	N Y #F –
c+	N Y HU –	N N GU –	N N GU –	N N HU –	C Y MA –	N Y #F –
c-	N Y CA –	N Y #F –	N Y #F –	N Y #F –	N N GU –	N Y #F –

313	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA –	C Y F –	C Y F –	C Y CA –	C N F M	C Y UG –
b-	N Y CL –	N Y #F –	N Y #F –	N Y CL –	N Y UG –	N Y UG –
c+	N Y CL –	F N F M	F N UG M	C N CA M	N Y UG –	F Y UG –
c-	N N CL M	F N F M	F N UG M	F Y CS –	N Y UG –	N Y UG –

314	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F –	N Y #F –	N Y #F –	N Y #F –	N Y #F –	N Y #F –
b-	N Y #F –	N Y #F –	N Y #F –	N Y #F –	N Y #F –	N Y #F –
c+	N Y HU –	N Y HU –	N Y HU –	N Y HU –	N Y UN –	N Y HU –
c-	N Y HU –	N Y HU –	N Y #F –	N Y HU –	N Y HU –	N Y HU –

315	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y S –	N Y #F –	N Y #F –	N N OP O	N Y UG –	N Y UG –
b-	N N HU F	N Y UN –	F Y F –	F Y CA –	F Y MA –	F Y UG –
c+	C Y CS –	F Y HU –	F Y F –	F Y CL –	F Y DT –	F Y AO –
c-	F N HU –	F Y F –	F N F M	F Y CL –	F Y UG –	F Y AO –

316	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y HU -	N Y #F -
c+	N Y HU -	N Y #F -	C Y F -	N N CL M	N Y #F -	N Y UG -
c-	N N GU -	N Y #F -	N Y HU -	N Y HU -	N N GU -	N Y UG -

318	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C N F M	N Y UN -	N Y GU -	N Y #F -	N Y UG -
b-	N N GU -	N Y UN -	N Y UN -	F Y UN -	N N GI GI	N Y UG -
c+	C Y CA -	N N UN -	N N UN -	C Y CA -	N N GU -	N N UG M
c-	N N GU -	N N DT M	N N GU -	N Y CS -	N N GU -	N Y UG -

319	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y F -	C Y AO -
b-	F Y CA -	F Y F -	F Y F -	F Y S -	F Y UN -	F Y AO -
c+	C Y CS -	C Y F -	C Y F -	C Y CA -	C Y F -	C Y AO -
c-	F Y CA -	F N F F	F N GI GI	F Y CA -	F Y UG -	F Y AO -

320	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CS -	C Y F -	C Y F -	C Y CA -	C Y F -	C Y AO -
b-	N N UN -	N Y DF -	N Y UG -	N Y #F -	N Y UN -	N Y UG -
c+	C Y CA -	C Y F -	C Y F -	C Y CL -	C Y F -	C Y AO -
c-	N Y UN -	N N DF M	N Y DF -	N Y CL -	N N DF M	N Y DF -

321	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	N Y HU -	N Y CL -	N Y UG -	N Y UG -
b-	N Y CL -	N Y #F -	N Y HU -	N Y HU -	N Y GU -	N Y GU -
c+	C Y CL -	C N F M	C N F M	C Y CL -	F N UG M	N N GU -
c-	F Y CL -	F Y UG -	F Y UG -	F Y CL -	F Y UG -	F Y UG -

322	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y HU -	C Y F -	C Y F -	C Y CL -	C Y AO -	C Y #F -
b-	F Y HU -	F Y F -	F Y F -	F Y HU -	N Y UN -	F Y AO -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	F Y CS -	N Y #F -	N N GU -	F Y CS -	F Y UG -	F Y UG -

323	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	C Y S -	N Y #F -	N Y #F -
b-	N Y #F -	N Y #F -	N Y HU -	N Y #F -	N Y #F -	N Y #F -
c+	N Y CL -	C Y F -	C Y F -	C Y CA -	C Y F -	C Y UG -
c-	N Y UN -	F N UG M	F Y UG -	F Y CL -	F Y UG -	F Y UG -

325	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	F Y CL -	F Y F -	F Y #F -	F Y HU -	F N AO F	N Y GU -
b-	F Y HU -	F Y F -	F N F M	F Y HU -	F Y UN -	F N GU -
c+	C N UN M	F Y F -	N Y HU -	F Y CL -	F Y AO -	F Y AO -
c-	F Y CS -	N Y HU -	N N HU F	F Y CL -	F Y AO -	F Y AO -

326	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y CS -	C Y F -	C Y UG -	N Y CL -	C N MA F	N Y UN -
b-	N N UN -	N N GU -	N N GU -	N Y CL -	N Y #F -	F Y MA -
c+	C Y CA -	C Y F -	C Y F -	C Y CA -	C Y MA -	C Y AO -
c-	N Y CL -	N Y HU -	F Y DF -	N Y CL -	F N UN -	N N UN -

327	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	N Y UN -	N Y UN -	C Y CA -	C Y F -	C Y AO -
b-	F Y CA -	F Y F -	F Y F -	F Y S -	F Y UN -	F Y AO -
c+	N Y CS -	C Y F -	C Y F -	C Y CA -	C Y F -	C Y AO -
c-	N N CS M	F Y F -	N Y UN -	N Y CS -	- ? ? -	N Y UG -

328	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y UN -	N N GI GI	N Y HU -	N Y UN -	N Y #F -
b-	N Y #F -	N Y UN -	N N GI GI	N Y CS -	N Y UG -	N Y UG -
c+	C Y CS -	C Y F -	N N GI GI	N Y CL -	C Y MA -	N N UG M
c-	N Y CL -	- ? ? -	N N GI GI	N Y CS -	N Y UN -	N N UG M

329	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y CL -	F Y F -	C Y F -	N Y CL -	C Y #F -	F Y AO -
b-	N Y CL -	F N F M	F Y F -	N Y CL -	F Y MA -	N Y #F -
c+	C Y CA -	C Y F -	C N F F	C Y CA -	C Y MA -	C Y AO -
c-	F Y CA -	- ? ? -	F Y F -	F Y CA -	N N UN -	F Y UG -

330	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	C ? ? -	C Y CA -	C N GI GI	C Y AO -
b-	F Y #F -	F Y F -	- ? ? -	N Y #F -	- ? ? -	N Y UN -
c+	C Y CA -	C Y F -	N ? ? -	C Y CA -	C ? ? -	C Y AO -
c-	- ? ? -	F N F M	N N GI GI	F N CA -	- ? ? -	- ? ? -
331	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y HU -	N Y #F -
b-	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -	N Y #F -
c+	N Y #F -	N Y #F -	N N GU -	N Y #F -	N Y #F -	N Y #F -
c-	N Y #F -	N Y #F -	N N GU -	N Y #F -	N Y #F -	N Y #F -
332	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	N Y #F -	N Y #F -	N Y UG -	N Y #F -
b-	N Y #F -	N Y UG -	N Y #F -	N Y CL -	- ? ? -	N Y UN -
c+	N Y CL -	N N UG F	N Y UG -	N Y CL -	N Y UG -	N Y UN -
c-	N Y CL -	N Y UG -	N Y UG -	N Y CL -	N Y UG -	N Y UG -
333	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	C Y CA -	N Y #F -	C Y F -	C Y CA -	C Y #F -	N Y #F -
b-	F Y UN -	F N UN -	F Y F -	N Y #F -	N Y #F -	F Y AO -
c+	C Y CL -	C Y UN -	N Y UG -	C Y CA -	C N F M	C Y AO -
c-	F Y CS -	F N UN -	- ? ? -	N N GU -	N N GU -	N Y HU -

334	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y CL -	N Y HU -	N Y #F -	N Y CL -	N Y #F -	N Y HU -
b-	N Y #F -	N Y HU -	N Y #F -	N N GU F	N Y #F -	N Y #F -
c+	F N CS F	N Y HU -	N N HU -	N Y CL -	N Y UG -	N Y UG -
c-	N Y #F -	N Y UG -	N Y UG -	N Y CL -	N Y UG -	N Y UG -
335	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C N GI GI	N Y GU -	N Y #F -	N Y UG -	N Y #F -
b-	N Y HU -	N Y #F -	N Y #F -	N Y #F -	N Y HU -	N N GI GI
c+	C N CA M	- ? ? -	N N GU -	N N GU -	N N GU -	N Y UN -
c-	O Y CA -	N ? ? -	F N GU -	N N GU -	N N GU -	F Y UG -
336	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+	N Y #F -	C Y F -	C Y F -	C N CA M	N Y #F -	N Y #F -
b-	N N HU -	N Y #F -	N Y #F -	N N GU F	N Y GU -	N Y #F -
c+	N Y HU -	N Y #F -	N Y #F -	N N HU -	N Y #F -	N N GU -
c-	N Y HU -	N Y HU -	N Y HU -	N Y HU -	N Y HU -	N Y #F -
	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
b+						
b-						
c+						
c-						

APPENDIX C

NUMBER SET ASSIGNMENT FOR NUMBER TRIPLES

Number Set Assignment

Level	Student ID#															
	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116
b+	1	1	1	1	4	3	2	3	3	5	6	3	6	2	4	2
b-	4	4	4	4	1	6	5	6	6	2	3	5	2	4	1	5
c+	3	3	3	3	5	2	1	2	2	6	4	5	2	4	5	1
c-	5	5	5	5	1	4	3	4	4	2	6	4	1	3	1	3

Level	Student ID#															
	117	118	119	120	121	123	124	125	127	128	129	130	131	132	133	134
b+	4	3	1	4	3	4	5	6	2	6	3	6	5	5	3	6
b-	6	6	3	1	2	1	2	2	5	3	5	2	2	1	5	2
c+	3	2	6	5	1	5	6	2	1	3	5	2	6	1	5	2
c-	2	4	5	1	4	1	2	1	3	6	4	1	2	6	4	1

Level	Student ID#															
	135	136	137	139	141	142	143	144	147	148	151	152	153	154	155	158
b+	2	6	4	2	4	1	1	4	2	6	5	6	5	3	6	5
b-	4	3	6	4	6	3	3	3	6	4	2	3	1	2	5	4
c+	4	4	3	4	3	6	6	3	1	2	6	4	1	1	5	4
c-	3	6	2	3	2	5	5	6	2	3	2	6	6	4	2	1

Level	Student ID#															
	159	160	162	163	164	165	166	167	168	169	170	171	172	173	175	176
b+	3	1	5	2	2	1	4	4	3	6	4	5	5	6	5	1
b-	5	6	1	1	1	5	2	3	2	5	6	3	3	4	4	6
c+	5	2	1	6	6	5	3	3	1	5	3	6	6	2	4	2
c-	4	5	6	3	3	6	4	6	4	2	2	1	1	3	1	5

Level	Student ID#															
	177	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315
b+	4	5	3	4	4	2	5	1	1	5	6	1	5	2	3	5
b-	2	4	6	6	2	4	3	5	4	1	2	3	1	1	2	2
c+	3	4	2	3	3	4	6	1	3	1	2	6	1	6	1	6
c-	4	1	4	2	4	3	1	3	5	6	1	5	6	3	4	2

Number Set Assignment

Level	Student ID# 316	318	319	320	321	322	323	325	326	327	328	329	330	331	332	333
b+	6	2	1	4	6	2	4	5	6	5	3	4	6	5	4	3
b-	5	1	3	1	3	5	3	2	3	4	5	3	2	3	6	2
c+	5	6	6	5	4	1	3	6	4	4	5	3	2	6	3	1
c-	2	3	5	1	6	3	6	2	6	1	4	6	1	1	2	4

Level	Student ID# 334	335	336
b+	1	6	6
b-	6	5	4
c+	2	5	2
c-	5	2	3

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Center Director

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Area Chairperson
Studies in Language:
Reading and Communication

Marvin J. Fruth
Area Chairperson
Studies in Implementation
of Individualized Schooling

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Area Chairperson
Studies of Instructional Programming
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